

07-SC-06, Project Engineering and Design (PED), National Synchrotron Light Source II

1. Significant Changes

Additional Other Project Costs (OPC) funds were provided to the NSLS-II project in FY 2006 for conceptual design activities following approval of CD-0 by the Deputy Secretary on August 25, 2005. Approval of CD-0 allows the start of the Conceptual Design Report (CDR). The challenging technical specifications described in the CD-0 required a more extensive CDR process than originally anticipated.

2. Design, Construction, and D&D Schedule

	(fiscal quarter)					
	Preliminary Design start	Final Design Complete	Physical Construction Start	Physical Construction Complete	D&D Offsetting Facilities Start	D&D Offsetting Facilities Complete
FY 2007	2Q FY 2007	4Q FY 2008	N/A	N/A	N/A	N/A
FY 2008	2Q FY 2007	2Q FY 2009	N/A	N/A	N/A	N/A

3. Baseline and Validation Status^a

	(dollars in thousands)					
	TEC	OPC, except D&D Costs	Offsetting D&D Costs	Total Project Costs	Validated Performance Baseline	Preliminary Estimate
FY 2007	75,000	46,000	N/A	121,000	N/A	121,000
FY 2008	75,000	50,800	N/A	125,800	N/A	125,800

4. Project Description, Justification, and Scope

The National Synchrotron Light Source II (NSLS-II) would be a new synchrotron light source, highly optimized to deliver ultra-high brightness and flux and exceptional beam stability. It would also provide advanced insertion devices, optics, detectors, robotics, and an initial suite of scientific instruments. Together, these can enable the study of material properties and functions with a spatial resolution of about 1 nm, an energy resolution of about 0.1 meV, and the ultra-high sensitivity required to perform spectroscopy on a single atom.

Major advances in energy technologies will require scientific breakthroughs in developing new materials with advanced properties. A broad discussion is given in several recent reports, including the Basic Energy Sciences Advisory Committee Reports *Opportunities for Catalysis in the 21st Century* and *Basic Research Needs to Assure a Secure Energy Future*, the Basic Energy Sciences (BES) reports *Basic Research Needs for the Hydrogen Economy* and *Basic Research Needs for Solar Energy Utilization*, the Report of the Nanoscale Science, Engineering, and Technology Subcommittee of the National Science and Technology Committee *Nanoscience Research for Energy Needs*.

^a The estimates in section 3 are for PED only. The full project TPC (design and construction) range approved at Critical Decision-0, Approve Mission Need, excluding offsetting D&D, is \$600,000,000 to \$800,000,000. This estimate is preliminary and should not be construed to be a validated project baseline.

Collectively, these reports underscore the need to develop new tools that will allow the characterization of the atomic and electronic structure, the chemical composition, and the magnetic properties of materials *with nanoscale resolution*. Needed are non-destructive tools to image and characterize buried structures and interfaces, and these tools must operate in a wide range of temperature and harsh environments. The absence of any tool possessing these combined capabilities was identified as a key barrier to progress in the 1999 BES Report *Nanoscale Science, Engineering and Technology Research Directions*.

In order to fill this capability gap and to further the accomplishment of its mission, the Office of Science has determined that its mission requires a synchrotron light source that will enable the study of material properties and functions, particularly materials at the nanoscale, at a level of detail and precision never before possible. NSLS-II will provide these capabilities. Only x-ray methods have the potential of satisfying all of these requirements, but advances both in x-ray optics and in x-ray brightness and flux are required to achieve a spatial resolution of 1 nm and an energy resolution of 0.1 meV.

There are no alternative tools with a spatial resolution of 1 nm and energy resolution of 0.1 meV that also have the required capabilities of being non-destructive and able to image and characterize buried structures and interfaces in a wide range of temperatures and harsh environments. An analysis found that upgrading existing light sources was either impossible or not very cost effective. In the case of NSLS-I, it was found that it would be impossible to upgrade this light source due to numerous technical difficulties, including accelerator physics and infrastructure constraints, such as its small circumference, which limit the feasible in-place upgrade options.

Research and Development activities funded under Other Project Costs will address technical risk in four key areas: energy resolution, spatial resolution, superconducting undulators, and superconducting storage ring magnets.

The NSLS-II project may design, build, and install the accelerator hardware, experimental apparatus, civil construction, and central facilities required to produce a new synchrotron light source. It includes a third generation storage ring, full energy injector, experimental areas, and appropriate support equipment, all housed in a new building.

The Project Engineering and Design (PED) funds requested for NSLS-II will allow the project to proceed from conceptual design into preliminary and detailed design. These funds will assure project feasibility, define the scope, provide detailed estimates of construction costs based on the approved design, develop working drawings and specifications, and provide schedules for construction and procurements. Should a decision to proceed with construction be reached, this design effort will ensure that construction could begin on schedule in FY 2009.

The project will be conducted in accordance with the project management requirements in DOE Order 413.3A and DOE Manual 413.3-1, Program and Project Management for the Acquisition of Capital Assets. The project costs presented in this datasheet are preliminary estimates for project engineering and design only. The preliminary schedule for project Critical Decisions is as follows:

Compliance with Project Management Order

- Critical Decision-0: Approve Mission Need—4Q FY 2005
- Critical Decision-1: Approve Alternative Selection and Cost Range—2Q FY 2007
- Performance Baseline External Independent Review Final Report—1Q FY 2008

- Critical Decision-2: Approve Performance Baseline—1Q FY 2008
- Critical Decision-3: Approve Start of Construction—4Q FY 2008
- Critical Decision-4: Approve Start of Operations—FY 2013

5. Financial Schedule

(dollars in thousands)

	Appropriations	Obligations	Costs
Design by Fiscal Year			
2007	20,000	20,000	19,000
2008	45,000	45,000	39,000
2009	10,000	10,000	17,000
Total, Design PED	75,000	75,000	75,000

6. Details of Project Cost Estimate

Total Estimated Costs

(dollars in thousands)

	Current Estimate	Previous Estimate
Preliminary and Final Design	75,000	75,000

Other Project Costs

(dollars in thousands)

	Current Estimate	Previous Estimate
Conceptual Planning	5,800	1,000
R&D	45,000	45,000
Total, OPC	50,800	46,000

7. Schedule of Project Costs

(dollars in thousands)

	Prior Years	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	Outyears	Total
TEC(Design)	19,000	39,000	17,000	—	—	—	—	75,000
OPC (Design)	30,800	20,000	—	—	—	—	—	50,800
Total, Project Costs (Design)	49,800	59,000	17,000	—	—	—	—	125,800

8. Related Operations and Maintenance Funding Requirements

Not applicable for project engineering and design.

(Related Funding Requirements)

Not applicable for project engineering and design.

9. Required D&D Information

Not applicable for project engineering and design.

10. Acquisition Approach (formerly Method of Performance)

A formal acquisition strategy will be prepared prior to CD-1 estimated for 1Q FY 2007.